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## **Watercraft**

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## **Technical Field**

10 The invention relates to a watercraft according to the preamble of the first claim.

## **Prior Art**

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Watercraft, in particular, boats and yachts, are generally fabricated in a procedure by which the lower section, called the hull, is composed of a hydrodynamically shaped section and is dimensioned having an appropriate wall height and wall  
20 thickness so as to resist strong wave action or grounding, and sometimes as well so as to allow as little water as possible to come over the deck.

The upper section of the boat, called the deck, is the closing component of the hollow hull and contains the infrastructure for the hold and living quarters, the  
25 helmstand, and appropriate sealing measures against the intrusion of water into the hull.

Located under the deck is the drive motor which is mounted directly on hull reinforcements. Connected directly to the hull are the propeller system including the  
30 propeller bracket, Z-drive, jet drive, or outboard motor, rudder, motor cooling elements, and exhaust pipes.

The hull and deck are usually glued, riveted or screwed together at the level of the sheer rail, the joined parts being elegantly concealed by the sheer rails.

5 A known aspect of watercraft is the fact that vibrations and oscillations caused by the mechanical components and by wave action are transmitted to the entire watercraft shell, the latter acting as a giant resonance chamber. Simply placing the motor and transmission on rubber mounts succeeds in partially reducing vibrations and oscillations.

10 Other approaches to increasing passenger comfort in watercraft are known, such as, for example, external hull-section damping means as provided in US 3,270,701 or internal hull-section damping means as provided in US 5,465,678; however, these do not meet specified requirements in regard to reliable a damping function and leveling.

### Description of the Invention

20 The goal of the invention is to provide a reliable damping function and leveling in a watercraft of the species indicated in the introduction.

This goal is achieved according to the invention by the features of the first claim.

25 The core aspect of the invention is thus that the watercraft has at least two floating bodies stacked one on top of the other, that the two floating bodies are joined by at least one connecting means, that a damping means is located between the two floating bodies, and that the intermediate space between the two floating bodies is  
30 sealed by sealing means.

By dividing the watercraft into two floating bodies or hull sections, that hull section which has to bear the main hydrodynamic buoyancy function, load, and vibrations and oscillations generated by the machinery, as well as wave impacts, is isolated and is designed as an independent floating body which accommodates the motor, transmission, control elements, attachment means, etc. In addition, the second hull section is also designed as a separate floating body and performs secondary hydrodynamic functions, such as, for example, lateral routing of the water flow, as well as providing a living- and work-compatible space for the crew of the watercraft. This second upper hull section is attached in a saddle-mountable fashion via movable attachment elements to the floating body located under it, the two floating bodies having a damping means between the two sections as well as a seal between these sections to prevent water from impairing the damping function. Both bodies have a flexible coupling means which easily enable the power supply, electrical signals, steering means, motor power means, reversing means to be interconnected.

Having two independent floating bodies not only enhances vessel safety but also provides a simple and cost-effective way of limiting any vibrations and oscillations caused, for example, by the motor, transmission, and propeller to a defined space while as much as possible decoupling this space from the remaining space. In addition, other initiators of vibration and oscillations such as wave impacts and possible propeller cavitation impacts are also not transmitted to the entire watercraft.

Between the two sections, the two stacked floating bodies possess an elastic means which acts as a damping medium. This can be a compressible medium such as, for example, a rubber element or fillable expanding body, or a shock absorber system similar to those known from the automotive field.

Damping can be controlled either passively or actively by an appropriate electronic system, whereby in the case of active damping the optimum damping rate is computed and adjusted by sensors. Active damping also allows the damping travel distance to be controlled such that the upper floating body can be raised so as to

receive less spray from the water, or lowered in order to present the smallest possible profile to the wind.

In addition, the vibration damping can be made more sophisticated by having two individual control systems – a primary and a secondary system – specifically such that the two control circuits communicate with each other so as to implement the best damping. The lower floating body control system primarily controls hydrodynamic motion, for example, via trimming and stabilizing flaps or side stabilizing fins, propeller drive angle adjustment, etc.

The upper floating body control system implements control, for example, through vertically acting hydraulic or pneumatic elements to ensure the most stable, horizontally oriented upper floating body.

In addition, a passive or active horizontal damping means can be used to filter impacts occurring on the lower floating body when entering waves, thereby further enhancing comfort in the upper section.

In addition, at least one movable and guided connecting element is present between the two body units so that the watercraft, comprising the lower floating body and upper floating body, is held together, and so that these are moved neatly parallel to each other; however, it can also include a more complex, for example, car-dan-type suspension system.

A seal of the intermediate space between the lower floating body and the upper floating body is required for the damping function to work properly. If water would collect in the intermediate space between the lower floating body and upper floating body, damping could no longer be ensured since the water is not compressible and must first be forced out to allow for a damping effect between the components. In response to a relief of damping, a vacuum might result, and water would be sucked into the intermediate space, thereby causing the watercraft to take on additional weight. For this reason, a circumferential, elastic and secure seal pro-

vided by an appropriate sealing device and sealing means is an essential component of a reliably functioning damping device.

5 A suitable bilge pump ensures that even in the event of minor damage to the seal, any intrusion of water would be automatically expelled from the intermediate space.

In addition, a relieving line allows the volume differential in the intermediate space to be compensated during the damping process.

10 Additional advantageous embodiments of the invention are presented in the subordinate claims.

### 15 Brief Description of the Drawing

20 The following discussion explains embodiments of the invention in more detail based on the drawings. Identical elements in the various figures are provided with identical reference numbers.

25 Fig. 1 is a side view of a watercraft which has a lower floating body separated from an upper floating body;

Fig. 2 is a side view of a watercraft ready for operation which has the lower floating body connected to the upper floating body;

30 Fig. 3 shows a horizontally acting damping means;

Fig. 4 is a rear view of a seal relevant for damping located between the lower floating body and the upper floating body;

5 Fig. 5 is a front view of the seal relevant for damping located between the lower floating body and the upper floating body;

Fig. 6 is a sectional view of the seal relevant for damping.

10 Only those elements essential to a direct understanding of the invention are shown.

## 15 **Way of Implementing the Invention**

Fig. 1 shows a watercraft comprising a lower floating body 1, an upper floating body 2, as well as drive means 3, 4, and steering/control means 6, in the separated state. Lower floating body 1 of the watercraft can be hydrodynamically optimized for a specified load and travel speed. Upper floating body 2 is placed over lower floating body 1 and can have any appropriate recesses to meet the space requirement for a motor 3, living space, working space and hold 5, the helm-stand 6.

25 Lower floating body 1 serves primarily as the main buoyancy body and preferably has an overall height which approximately corresponds to the level of the waterline when the watercraft is in the loaded state. In terms of construction engineering, the situation may arise in which a drive motor, and possibly the fuel tank, project above this waterline, with the result that these elements will need to be protected from possible contact with the water by an appropriately higher side wall.

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Fig. 2 shows a watercraft ready for operation, wherein lower floating body 1 – comprising motor 3, drive unit 4, a fluid tank 9 – is connected to upper floating body 2 by guide elements 17<sup>1</sup>, attachment points 8, and damping means 10, 11.

5 Also shown are the living space, working space and hold 5, as well as the helmstand 6 which can be connected by coupling means 13 to the lower floating body so that the steering/control and drive elements are able to interact with the helmstand. In addition, sealing means 12 are shown which seal off intermediate space 14 from seawater and foreign bodies, the intermediate space having an air ex-  
10 changing means 15 and a bilge pump 16

Attachment of lower floating body 1 to upper floating body 2 is effected through damping means 10, 11 so that motor vibrations and oscillations – in addition to wave impacts, drive-unit vibrations, or propeller vibrations – are isolated from up-  
15 per floating body 2. Damping can be effected either by passive means 10, such as elastically compressible means or inflatable tubes, or by active pneumatic or hydraulic damping means 11 which can additionally be controlled by an electronic system.

20 In addition, active filling of damping means 11 enables upper floating body 2 to be set higher or lower as required, while also allowing the damping travel to be increased or decreased independently.

Flexible coupling 13 connects all technical means related to making the watercraft  
25 operationally ready, the majority of which leads to helmstand 6, such as electric lines for the motor instrument displays, control lines for the trimming and stabilizing flaps, side thrusters, additionally separate power for the galley, cabin illumination, external markers of the watercraft, etc., as well as the mechanical connections such as, for example, transmission reversal, motor power and rudder func-  
30 tion control. Helmstand 6 advantageously includes the steering, power lever, transmission, displays, and actuators for the technical means such as the trim-

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<sup>1</sup> translators note: reference number corrected based on context.

ming and stabilizing flaps, propeller adjustment, and the side thruster. The control commands and other functions indicated above may, if required, also be transmitted wirelessly, by radio, for example, between the two floating bodies.

- 5 In addition to the vertical damping means, a horizontal damping means is provided which enables an additional impact delay in response to entrance into waves. Fig. 3 shows a horizontally fixed damping means 10, 11 which is attached on one end to lower floating body 1 by attachment point 8, and on the other end to upper floating body 2 similarly by an attachment point 8.

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- Figs. 4 and 5 illustrate the central sealing element 12 for the damping function between lower floating body 1 and upper floating body 2. In order to prevent the admission of both water – since this medium is incompressible and would therefore impair the damping function – and foreign bodies, such as mud, seal creatures,  
15 into intermediate space 14 between lower floating body 1 and upper floating body 2, a sealing element 12, for example, a circumferential band has been applied. Sealing element 12 can be designed so that it is able also to participate in the process given active leveling, for example, when large height differences are set between lower floating body 1 and upper floating body 2.

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A relieving line 15 in the form of an air exchanging means allows for an exchange of air between intermediate space 14 and the outer environment (atmosphere), and can also be employed for the function of bilge pump 16 in response to an unwanted admission of water.

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- Fig. 6 shows sealing element 12 as well as the connection of the two floating bodies 1 and 2 in detail. Sealing means 12 here is designed, for example, in tubular form and is thus able to compensate for movements made by the two floating bodies relative to each other. This type of sealing means 12 can at the same time be  
30 employed as passive damping means 10. The tubular sealing means can be filled with air such that damping is able to be adjusted via the pressure, with the result



that active damping can be generated even in the event of changes in the pressure during operation.

Lower floating body 1 is connected to upper floating body 2 by connecting means 7, attachment point 8, a guide means 17 and a stop 18. The ability of the two floating bodies to move relative to each other is limited by guide means 17 and stop 18. An additional damping means 10 can be advantageously located between guide means 17 and stop 18, thereby further damping the motion.

It is of course also possible to design sealing element 12 as a skirt or in a different form.

It is of course understood that the invention is not limited to the embodiment shown and described.

#### List of Reference Notations

- |    |                                 |
|----|---------------------------------|
| 1  | lower floating body             |
| 2  | upper floating body             |
| 3  | motor                           |
| 4  | drive unit                      |
| 5  | living, working space, and hold |
| 6  | helmstand                       |
| 7  | connecting means                |
| 8  | attachment points               |
| 9  | liquid tank                     |
| 10 | passive damping means           |
| 11 | active damping means            |
| 12 | sealing means                   |

- 13 coupling means
- 14 intermediate space
- 15 air exchange means
- 16 bilge pump
- 5 17 guide means
- 18 stop